RESULTS

BIRD SPECIES OF SPECIAL CONCERN 2002

The criteria and ranking scheme identified 79 taxa that currently warrant designation as Bird Species of Special Concern in California (Table 1). Of these, 11 qualified solely on the basis of meeting one of the criteria of the definition of a species of concern: 5 because they had been extirpated from the state entirely or in their primary seasonal or breeding role, 6 because they had been listed as federally, but not state, threatened or endangered. These 11 taxa are not discussed further as conservation efforts are already mandated for federally listed taxa and little can be done to benefit extirpated taxa, except perhaps to reintroduce the sharp-tailed grouse.

Sixty-eight taxa warranted designation because they qualified for immediate conservation concern on the basis of their scores for seven biological criteria (Table 1). These taxa were placed within three categories of conservation concern: 22 as First Priority, 24 as Second Priority, and 22 as Third Priority. Of the 68 taxa, 42 were full species (monotypic species or polytypic species represented by only one subspecies in California), 23 were subspecies (of species with multiple subspecies within California), and 3 were distinct populations of species. In the latter category, the populations of the Le Conte's thrasher (San Joaquin population) and the song sparrow ("Modesto" population) have been assigned subspecific rank by some authors (see accounts). Regardless, these populations and that of the snowy plover (interior population) show substantial or complete isolation from other populations of their respective species in California.

LINEAR VERSUS CATEGORICAL RANKING SCHEMES

The *linear* and *categorical* schemes showed a relatively high degree of agreement in identifying taxa for inclusion on the BSSC list. Of the 68 taxa on the final list, 51 (75%) were common to both schemes. The *linear* scheme was more liberal and identified 65 taxa for inclusion, the *categorical* 54 (Appendix 1). However, the ability of both schemes to similarly classify taxa into the three levels of priority was poor (Spearman Rank Correlation; rho = 0.024, $P = 0.84$).

CORRELATION AMONG SCORES

An analysis of possible correlations among criteria scores for all nominated taxa showed that several criteria were significantly positively correlated. We found that the strongest positive correlations were between RT/PT, RS/PS, and PC/PS (Table 2). For example, taxa that tend to score high on Endemism also tend to score high on Range Size. There were also three significant negative correlations, though the relationships were never strong (i.e., rho for all $\leq$ -0.14). Strong correlations indicate that scores are not independent.

COMPARISON WITH PRIOR LISTS

Comparison of the lists of birds of special concern for 1978 and 2002 is difficult because the former was derived subjectively, the latter via an objective ranking scheme. Still, there are some obvious differences between these lists (Table 3). The major reasons for the changes since 1978 are the removal of various taxa because of their listing as state threatened or endangered, the addition of subspecies to the 2002 list, changes in the status of various species in the intervening years, and the change in methods for deriving the list. Since 1978, eight taxa on the original special concern list have been listed as state

threatened (Swainson's hawk, greater sandhill crane, bank swallow) or endangered (marbled murrelet, gila woodpecker, gilded flicker [formerly subspecies of common flicker], willow flycatcher [all California subspecies], Arizona bell's vireo). In 2000, the short-tailed albatross was listed as federally endangered. Hence by the 2002 definition it qualified for special concern status as a federally, but not state, listed taxon; prior to that it would have qualified as a species that had been extirpated from California waters in its primary seasonal role. The 1978 list included two subspecies in the "highest priority" category but explicitly excluded consideration of any subspecies for inclusion in the other two priority categories (Remsen 1978). As noted above, the two subspecies on the 1978 special concern list have both since been listed as state endangered. Still, 24 subspecies have been added to the special concern list from 1978 to 2002 (Tables 1 and 3).

Reasons for other changes in the list from 1978 to 2002 are less clear because it is not certain what would have been included on the 1978 list if it had used the same objective ranking criteria as in 2002. In some cases, the ability to evaluate some taxa has been enhanced in 2002 over 1978 by the recent availability of more or higher quality data (e.g., Black Tern, Shuford et al. 2001). Regardless, the following species included on the 1978 but not the 2002 list have all experienced recent population increases in California: double-crested cormorant (Carter et al. 1992), white-faced ibis (Shuford et al. 1996, Earnst et al. 1998), osprey (Gould and Jurek 1988), Cooper's hawk (Calif. county atlas data), merlin (A. Fish/Golden Gate Raptor Observatory unpubl. data), and rhinoceros auklet (Carter et al. 1992). The California gull was not included on the 2002 list primarily because the main threat to the breeding population was reduced by a state water board order that will maintain lake levels at Mono Lake that will protect the state's

largest colony from ground predators (Shuford and Ryan 2000). The following taxa were added to the 2002 list in part because of substantial recent population declines or range retractions in California: wood stork, mountain plover, olive-sided flycatcher, California Swainson's thrush, grasshopper sparrow, and tricolored blackbird (see accounts). It is likely, though, that the reason that a large number of the 22 other taxa that were either removed (12) or added (10) to the list from 1978 to 2002 was solely because of the application of the new ranking scheme. Thus, on biological grounds there may not have been much of a change in the conservation status of these taxa between 1978 and 2002. Among those removed are six taxa (laughing gull, brown-crested flycatcher, Virginia's warbler, hepatic tanager, gray-headed junco, and northern cardinal) that reach the edge of their range in California. These taxa have either increased in population size (or colonized) California since the publication of Grinnell and Miller (1944), occur in such small numbers that their fate is likely greatly influenced by the dynamics of breeding populations in Arizona or Nevada (thus unlikely to benefit much from conservation efforts in California), or face no substantial threats to their well being (see Appendix 2).

OCCURRENCE BY HABITAT

The 68 ranked taxa occurred within nine broad habitat classes (Table 4). Wetlands held 29 taxa, grasslands 12, riparian forests and woodlands 12, scrub habitats 12, marine waters 6, conifer forests 6, desert woodlands 4, oak woodlands 3, and mixed evergreen forests 1. In their season of concern, 19 taxa use primarily interior wetlands, 10 coastal or near-coastal (e.g., Salton Sea) saline habitats; the San Francisco common yellowthroat uses a combination of saline and brackish estuarine marshes and near-coastal freshwater marshes and the Bryant's savannah sparrow uses a combination of estuarine marshes and

moist (upland) coastal grasslands. Of the 12 taxa occurring in riparian habitats, 6 use primarily desert riparian. All seven taxa identified as being of concern in the non-breeding season (wood stork, tule greater white-fronted goose, brant, lesser sandhill crane, mountain plover, Oregon vesper sparrow, large-billed savannah sparrow) use either wetlands, grasslands, or a combination of the two.

GEOGRAPHIC DISTRIBUTION

Ranked taxa were differentially distributed among the major geographic regions of the state (Table 5, Figures 1 and 2). Thirty-nine taxa (56%), though, occurred only in one or two major geographic regions, thereby increasing their susceptibility to actual and potential threats. As expected, many of these (16 of 39) taxa with restricted distributions are also endemic or near-endemic subspecies. Of the remaining species and subspecies (23 of 39) with restricted distributions within California, 14 are part of more widespread populations to the south or southeast that reach the edge of their range in southern California, 7 are part of more widespread populations to the north or northeast that reach the edge of their range in northern or central California.

The numerical occurrence of ranked taxa varied considerably among major geographic regions (Table 5, Figure 2). The highest total was 41 taxa in Southwestern California, where the list was bolstered by the occurrence of six endemic subspecies from the Channel Islands and seven taxa reaching the northern or northwestern limit of their range in California. Central Western California held the next highest total with 26 taxa, the total elevated by 3 endemic subspecies of song sparrow in San Francisco Bay. Totals for all other regions ranged from 17 to 22, except for the Cascade Range with 9 taxa. The latter region is a relatively small region with a limited suite of habitats and elevations.

At the level of ecologically-defined Bird Conservation Regions (BCRs), the disparity in number of special concern taxa among regions was more striking. BCR 32 (Coastal California) held 55 taxa whereas the number of taxa in the four other California BCRs ranged from 17 to 25 (Table 5, Figure 1). BCR 32, however, is entirely within California and comprises about one-half of the state, including all of the Sacramento and San Joaquin valleys as well as the taxa-rich Central Western and Southwestern California geographic regions. BCR 33 (Sonoran and Mohave Deserts) with 25 taxa comprises about one-quarter of the state. The remaining three BCRs, with their smaller totals of special concern taxa, combined comprise only about one-quarter of the state.

MONITORING AND RANGEWIDE SURVEYS

Information presented in species accounts indicates that population trends of birds of special concern as a whole are poorly monitored. Of 63 special concern taxa with breeding populations in California, only 10 were adequately monitored in the state by the Breeding Bird Survey (Table 6). Another XX breeding taxa are monitored by other methods or have *de facto* monitoring as a result of independent annual population censuses at all or most of their key nesting sites. The adequacy of these methods for detecting population trends, though, is unknown. Of the six taxa of concern in their non-breeding season, only the brant has an adequate program to monitor population trends. Three of the taxa of concern in the non-breeding season are subspecies (Tule white-fronted goose, lesser sandhill crane, Oregon vesper sparrow) that would need specialized monitoring programs because of the difficulty of identifying these taxa in the field. Some other cryptic taxa, such as the snowy and mountain plovers, would need specialized monitoring schemes or highly trained biologists because of the difficulty of finding many

individual birds. Some data are collected on numbers of mountain plovers in early winter in California by Christmas Bird Counts. These data, though, apparently are not adequate for trend assessment, and currently no up-to-date analyses are available for all species on CBCs (Sauer et al. 1996), in contrast to the regular updates of analyses of BBS data for breeding birds (Sauer et al. 2001).

The picture is only slightly brighter in terms of the number of special concern taxa that have been surveyed to determine population size throughout their California range in the last 20 years; many have never been surveyed in this manner (Table 6).

RESPONSIBILITY LIST OF BIRDS IN CALIFORNIA

In addition, 119 taxa qualified for a Responsibility List of Birds in California because all or a very high proportion of their global populations occur in the state (Table 7). Of these, 63 taxa are endemic, 56 near-endemic (>80% but <100% of entire population in California). This list includes three endemic species (California condor, island scrub-jay, yellow-billed magpie) and eight near-endemic species (ashy storm-petrel, mountain plover, Allen's hummingbird, Nuttall's woodpecker, wrentit, California thrasher, tricolored blackbird, Lawrence's goldfinch). All the rest are endemic or near-endemic subspecies, demonstrating the very high rate of subspecific endemism in California and adjacent states. Twenty-three taxa occurred on both the special concern and responsibility lists (Tables 1 and 7); 25 if the San Joaquin Le Conte's thrasher *(Toxostoma lecontei macmillanorum)* and Modesto song sparrows *(Melospiza melodia mailliardi)* are considered valid subspecies. Co-occurrence on the two lists indicates a particularly high level of conservation concern in California. Not only are these taxa

declining or vulnerable, but the concentration of their populations here indicates that conservation actions must focus particularly on California if they are to be successful.

TAXA TO WATCH

We identified an additional 29 taxa, not included on the special concern list, as "taxa to watch" on the basis of prior concern for the well being of their populations in California (Appendix 2).

DISCUSSION

UNITS OF CONSERVATION

Taxonomic concepts and hence the units considered for conservation are not stable, and even what constitutes a species, perhaps the primary unit of evolution, is much debated (e.g., Rojas 1992, Peterson 1998, Sangster 2000 and references therein). There is even more disagreement as to what lower taxonomic levels (subspecies, "distinct population segments," "evolutionarily significant units") should be the focus of conservation efforts (e.g., Ryder 1986, Moritz 1994, Pennock and Dimmick 1997, Waples 1998, Crandall et al. 2000, DeWeerdt 2002). Recent rapid advances in molecular genetics have lead to a much greater reliance on these methods in taxonomy, perhaps explaining, at least in part, why the AOU (1998) has recently side stepped the issue of subspecies. Presumably because of these uncertainties most lists developed for conservation prioritization focus on species (Table 3), despite the fact that many subspecies of birds have been listed as threatened or endangered at the state and federal level. Given the widespread concern for the loss of both species and the genetic diversity within them, a focus solely on species is likely to be shortsighted. Populations are being lost worldwide at a much more rapid rate than are species (Hughes et al. 1997), and many subspecies undoubtedly contain novel

adaptations that may be necessary to meet future environmental challenges (Crandall et al. 2000).

PERIPHERAL POPULATIONS

The primary arguments against paying special conservation attention to peripheral populations are that such efforts have little probability of success, given the marginal viability of populations at the edge of their range, and that it results in a skewed allocation of funds out of proportion to need (Hunter and Hutchison 1994, Peterson 2001). Conversely, protecting peripheral populations may preserve genetic diversity that adapts a population to shift its range in response to climate change, maintain the integrity of local ecosystems, assist many other species using the same habitat, and aid conservation on a broader scale by keeping taxa from reaching global endangerment (Hunter and Hutchison 1994). Also, the protection of any population is a value judgment, and people and organizations are more apt to feel protective of local resources and to act locally in their defense, particularly if they are organized along political boundaries. California, one of the most biologically diverse states, should protect all of its well-established populations whether widespread, centrally clustered, or at the margins of the state.

Care must be taken in classifying "peripheral populations," as this is not always straightforward and risks marginalizing taxa that warrant protection. For example, two breeding species in California that currently can be classified as "peripheral" – American white pelican and fulvous whistling-duck – were not always so restricted in range in the state. The pelican and the whistling-duck, now confined as breeders, respectively, to the northern margin of the state in the Klamath Basin and the southern margin in the Imperial

Valley, once overlapped broadly in breeding distribution in south-central and southern California (see accounts). Hence their current peripheral status is the result of large-scale retractions of their ranges, which should be vigorously protected against further erosion. The standard of considering for special concern status only taxa with well-established populations in the state should counter concerns that conservation efforts for peripheral populations will have little chance for success. Clearly, protection of peripheral populations should help stem range retractions that would lead to further reduction of California's avian biodiversity.

ELUSIVENESS OF A PERFECT RANKING APPROACH

In recent years, ranking schemes have been embraced as an important tool in bird conservation. The proliferation of schemes reflects in part the different purposes and scales for which they are designed and applied. Disagreement over the type of scheme to use when the purpose and scale are the same, though, (cf. Beissinger et al. 2000, Carter et al. 2000), appears to reflect the elusiveness of designing a system that can accurately measure the risks of extinction for a host of birds, each with unique ecological attributes, particularly given great variation in the knowledge of various biological factors both within and across taxa. The problem of comparing oranges and apples is compounded many fold when extending the comparison from storm-petrels to swifts, bitterns to blackbirds, and woodpeckers to wood-warblers. Consequently, virtually any ranking scheme has it shortcomings.

Beissenger et al. (2000) argued for the use of a categorical rather than linear approach to ranking the conservation priority of birds in North America. They considered the appeal of linear rankings schemes to be the ease with which variables can

be defined and the yielding of quantitative results with superficially unambiguous implications for management priorities. They listed major shortcomings of linear schemes, though, to be (1) incomplete data makes it difficult to choose variables and to decide whether all should be weighted equally, and (2) unintentional weighting can occur because of multicolinearity (or correlations) among variables. Like Beissenger et al., we too found strong correlations among the scores for criteria used to score potentially at-risk taxa (Table 2). The summing of scores in a linear scheme, to produce a list of taxa ranked in descending order from those with the highest to the lowest scores, gives a false sense of precision given the uncertainty of biological data and the difficulties of comparing across species with widely varying ecological characteristics. Linear schemes also suffer from the need to choose an arbitrary cutoff between the scores separating inclusion on versus exclusion from the list; this arbitrariness is compounded if the list is subdivided further into differing levels of conservation priority.

Categorical schemes have been criticized as being vague (Given and Norton 1993). Also, although they identify taxa both for inclusion on a list and within levels of priority based solely on one or a few criteria scores, the setting of the criteria that discriminate among categories are typically defined arbitrarily. Similarly, the difficulties of incomplete data presented above for linear schemes also apply to categorical ones.

Recognizing the limitations and strengths of both linear and categorical approaches to ranking birds for conservation concern, we ultimately ranked taxa in California using both approaches. When combining the results of both systems to produce a list with three levels of conservation priority, we gave each taxon the higher rather than lower of the priority rankings assigned by the two approaches. This was

judged the best and most conservative approach, as if mistakes were made it seemed better to rank (recommend) a taxon for too much conservation priority rather than for too little. The use of two approaches also yielded a list with more taxa than if only one of the schemes had been used. Again, this was judged more conservative to assign conservation priority to slightly more than less taxa.

HABITAT AND GEOGRAPHIC PATTERNS

The high representation of special concern taxa within wetlands, grasslands, riparian forests and woodlands, and scrublands (Table 4) is not surprising given these are the habitats with the highest rates of loss in California. Estimates indicate that California has lost over 90% of its original wetlands (Dahl et al. 1991), 95% of its riparian habitat (RHJV 2000), and 60% of its grasslands (CPIF 2000a). Although authors frequently emphasize these high rates, these percentages hide the true extent and complexity of the loss both in terms of structure and function. Degradation and fragmentation can have profound effects on biodiversity (Saunders et al. 1991, Debinski and Holt 2000). Among the greatest losses of ecosystem function affecting birds in California is that of our natural hydrology, which before human intervention greatly enhanced biological productivity both in space and time. The periodic flooding of areas such as the Central Valley and lower Colorado River valley formerly formed a diverse mosaic of permanent and ephemeral wetland and riparian habitats that depended on such perturbations for renewal (Rosenberg et al. 1991, Shuford et al. 2001). Restoring natural function to such habitats will be among the greatest conservation challenges in the state, though models exist for ways to meet human needs and also conserve the ecological integrity of riverine ecosystems (Richter and Richter 2000). Fortunately, efforts to conserve birds in the

habitats mentioned have greatly increased recently via joint ventures and regional working groups of the North American Waterfowl Management Plan (e.g., USFWS 1990), U.S Shorebird Conservation Plan (Brown et al. 2001, Page and Shuford 2000), and various California Partners in Flight bird conservation plans (e.g., CPIF 2000a, b; RHJV 2000).

THREATS

Vigilance is needed as threats facing birds change over time. In the 19th and early 20th century birds were heavily exploited for their feathers, meat, and eggs, but demand waned with legal regulations and changing attitudes (Wilcove et al. 2000). Similarly, in the last few decades reproductive impairment of birds has been greatly reduced by banning, regulating, and managing the use of toxic compounds (e.g., Boellstorff et al. 1985, Snyder-Conn et al. 1999). Today at-risk birds in California face a variety of threats but foremost among them is habitat loss, degradation, and fragmentation (see species accounts). Habitat loss is also the single greatest threat throughout the United States (Wilcove et al. 1998) and worldwide (Collar et al. 1994). Hence strategies to conserve at-risk birds in California must place a high priority on protection, restoration, and enhancement of their habitats.

PRIORITIZATION

The large number of prioritization schemes that are applicable to California at the state, national, or continental scale (Table 3) can confuse those attempting to set conservation priorities. Confusion may arise because various schemes are designed for different purposes or, especially, when lists mix short- and long-term conservation goals without so stating. For the latter reason we developed two lists for California: the species of

concern list (Table 1) and the responsibility list (Table 7). The former will serve best as a tool for short- to medium-term planning, the latter for medium- to long-term planning.

The species of concern list provides direction for conservation by identifying three levels of priority. Prioritization can be further refined by other factors. We recommend raising the priority of taxa that occur on both the special concern and responsibility lists (boldfaced in Tables 1 and 7), as these are not only in immediate need of protection but their continental or global conservation can be ensured only by actions taken mostly in California. Taxa warranting heightened consideration are ones on either of the two California lists that are also listed as "vulnerable" at the global scale by the IUCN (2000; see Table 3). These include species such as mountain plover and Xantus's murrelet. Priority might also be raised for funding for restoration, research, or monitoring if multiple species of special concern might benefit. Such a case might involve projects along the Colorado River that might simultaneously benefit special concern taxa such as Harris's hawk, vermilion flycatcher, crissal thrasher, Lucy's warbler, Sonora yellow warbler, and summer tanager as well as threatened and endangered taxa such as elf owl, gila woodpecker, gilded flicker, southwestern willow flycatcher, and Arizona bell's vireo. Projects of this sort might have a very high rate of return relative to expenditure. Because today so much conservation planning is habitat based, efforts to prioritize for the protection of species of special concern should be coordinated with other California plans for habitats such as grasslands, oak woodlands, and riparian forests and woodlands (CPIF 2000a, b; RHJV 2000). Priorities, though, sometimes may be superceded by opportunities, such that low priority species may fortuitously benefit from actions that occur in an area with no high priority species.

Evaluation of patterns of distribution of special concern taxa with respect to habitats and geographic areas of the state (Tables 4 and 5) may provide some additional insight for prioritization at the local, regional, or statewide level. Recognition of distribution patterns by habitat will alert those with management responsibility of various habitats of the special concern taxa most in need of conservation when prioritizing restoration or land acquisition. Similarly, knowledge of the distribution of these taxa by geographic areas will help local and regional planners address both human needs and those of birds most in need of protection. This may be especially important in areas such as coastal southern California, which holds a high number of species of concern, has lost vast tracts of native habitat, and faces ongoing development. These pressures are expected to intensify on the basis of projected rates of future population increase.

IDENTIFYING POSITIVE TRENDS

In contrast to lists of declining species, Gigon et al. (2000) proposed the creation of lists that enumerate the species on at-risk lists that have stable populations overall or are increasing in abundance. They reasoned that such lists can strengthen public motivation for conservation and advance self-confidence of conservationists by quantifying and stressing successes in conservation and by showing promising possibilities for action. To bolster such optimism, an important component of effective conservation (Beever 2000), it would be valuable in future revisions of the California bird species of special concern list to highlight increasing populations and any actions responsible for their recovery.

RESEARCH AND MONITORING

The need for research and monitoring to enable protection and recovery of birds of special concern has been recognized since the inception of the list (Remsen 1978). Our

evaluation of the effectiveness of current monitoring programs for these taxa indicates that progress in this realm has been modest in the last two decades. Effective monitoring programs are also needed for all "taxa to watch" and all nominees to the 2002 special concern list. Similarly, the many research needs listed in the species accounts highlight the importance of gathering more information to foster adaptive management for these birds by taking corrective action as new insights are gained (Walters 1986).

USING THE LIST TO FOSTER CONSERVATION

California possesses incredibly rich biodiversity because of its large size, diverse habitats and environmental heterogeneity, and relative isolation from the rest of the continent (Stein et al. 2000). In terms of its flora and fauna, California leads the nation in overall species richness, number of state endemics, and rare species. As of 2000, 613 species of birds have been documented for the state, including 289 native breeding species (CBRC 2000). In terms of regularly occurring species of birds, California ranks among the top four states in the nation (Stein et al. 2000); for subspecies of birds, it probably ranks at the very top. On a global scale, it is the only mainland region of the United States recognized as an Endemic Bird Area, because of its endemic and near-endemic bird fauna (Stattersfield 1998).

Along with the possession of such a rich bird fauna comes the responsibility for its protection. The species of special concern list by itself will not protect birds but it can serve as an important tool for those taking actions to conserve at-risk species. Given limited resources and ongoing habitat loss and degradation from a rapidly expanding human population, ways must be found to prioritize conservation actions. Conservation biologists have proposed a number of ways to design reserve networks and select areas

that have the highest need for protection. These include selection of hotspots, geographical areas with high species numbers (richness), endemism, rare or threatened species, with such areas varying with scale and time (e.g., Williams et al. 1996, Flather 1998, Reid 1998, Rutledge et al. 2001). Selection may also be made on the basis of surrogate species, including ones with large range sizes whose protection may also protect many other species (umbrella species) or ones that denote areas of high species richness (indicator species) (Lambeck 1997, Caro 2000, Rubinoff 2001). Chase et al. (2000), though, suggested that efforts to conserve birds of coastal sage scrub in southern California should not focus exclusively on rare species or on areas with the highest species richness but rather on a diverse suite of species representative of the range of variation in communities found in sage scrub habitats.

While too great a focus on single extremely rare species may be undesirable, a proactive approach that considers all native species equally may shift scarce resources away from species that could most benefit from them (Cassidy et al. 2001). Multi-species planning efforts can also benefit from knowledge gained from single-species conservation plans (e.g., Shuford 1999), as areas managed for multiple species may not necessarily provide extensive habitat for species with restricted needs (e.g., Shuford et al. 2001).

Others have emphasized biodiversity conservation at a landscape, ecosystem or habitat level that supports natural processes and their natural ranges of variability (e.g., Poiani et al. 2000). Clearly a balance must be struck. Regardless, a high priority should be placed on protecting both natural processes and species that are nearing endangerment because of declining populations or vulnerability to threats. The identification of such

species by the California species of special concern list gives conservationists a starting point from which to work regardless of the method of protection selected.

Protection, restoration, and enhancement of habitats for at-risk species will of necessity take a multi-faceted approach. Department of Fish and Game staff already consider species of special concern during the processes of environmental review (e.g., CEQA), conservation planning, and preparation of management plans for Department lands, and during inventories, surveys, and monitoring conducted by the Department or its cooperators. Habitat Conservation Plans and Natural Community Conservation Plans are innovative approaches (O'Connell and Johnson 1997, Harding et al. 2001) and seem well suited to addressing the needs of species of special concern. To be effective these efforts will need to be enhanced by the actions of other stakeholders, including other state, federal, and local agencies, private organizations, and landowners. Although some protection can be given by regulatory actions, other methods may prove more important. Such methods include public and private land acquisition, conservation easements, tax incentives, and cost-share programs for habitat enhancement (Bean 2000). Cooperative and proactive efforts among agencies and other groups and between managers and scientists tend to be the most effective in sensitive species protection (Squires et al. 1998).

Knowledge of the distribution of at-risk taxa can be useful in identifying Important Bird Areas (Grimmett and Jones 1989; for California, D. Cooper pers. comm.) thereby highlighting their need for protection. While creation of additional reserves is highly desirable, there has been an emphasis on terrestrial reserves at the expense of marine reserves (Lindholm and Barr 2001). There currently is a strong movement to

establish fully protected marine reserves (Roberts and Hawkins 2000, National Research Council 2001), which are needed in California. There also is recognition that protection of many migratory species will require cooperation across international borders (Commission for Environmental Cooperation 2000).

RECOMMENDATIONS

To promote advances in conservation of birds of special concern in California, we recommend the following:

- Establish a permanent Bird Species of Special Concern Technical Advisory Committee to meet annually to review the status of California's at-risk birds. The committee would vote on adding or removing taxa from the special concern list on the basis of documented information provided in support of requests for score changes to specific scoring criteria.
- Update and thoroughly revise the special concern report every five years, or more frequently if circumstances warrant it.
- Maintain an online database to track new information on special concern taxa and to document criteria scores and any changes made to them. The database's website should allow for online entry of new data on birds of special concern, following quality control protocols established by CDFG.
- Prepare a report to recommend specific, cost-effective protocols that can be used to monitor trends of all special concern taxa. Methods should strive to monitor multiple species simultaneously, produce statistically valid results with error estimates, and incorporate volunteers and citizen scientists whenever possible to both lower costs and broaden the constituency for protection of at-risk birds.

Monitoring goals should be well articulated to answer specific questions relevant to management (Noss 1990).

- Identify a volunteer coordinator to obtain and maintain volunteer support for monitoring programs of special concern birds.
- Prepare a report to recommend research priorities for the next decade that will provide needed information to enable better management to protect and aid recovery of populations of at-risk birds (see Mace et al. 2001, Soulé and Orians 2001). The report should prioritize research needs on not only the ecology of at-risk birds but also baseline distributional surveys needed to develop plans for habitat protection and taxonomic studies needed to broaden our understanding of what needs to be protected. Recommendations should include creative and novel approaches to fund such research.
- Develop an outreach program to inform biologists, land managers, and decision makers of the need to protect at-risk birds and of the best methods to do so. Materials should emphasize that money spent upfront to protect and maintain self-sustaining ecosystems will be far less than that needed later to fund costly recovery and restoration programs.
- Identify a Department liaison to coordinate with other multi-species conservation efforts to ensure these plans adequately address the needs of special concern taxa and, conversely, to gather information that can be used for multi-species planning for birds of special concern.

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